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Macro-invertebrate community diversity in relation to water quality status of Kunda River (M.P.), India

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ABSTRACT

Physico-chemical parameters and macro-invertebrate fauna of Kunda River at Khargone district Madhya Pradesh, India were studied from August 2010 to January 2011. Surface water and benthic samples were collected monthly from two sampling stations along the river. Mean values of surface water temperature of 29.66°C, pH 8.34, Transparency 40.56, Dissolved Oxygen 7.19mg/l, Biological Oxygen Demand (BOD) 4.29mg/l, Total Hardness 119.33, Alkalinity 307.49, chloride 26.72mg/l, nitrate 0.25mg/l, phosphate 0.36mg/l, Analysis of variance (ANOVA) showed significant difference ($p<0.05$) in the mean values of surface water temperature, pH, DO, BOD, from the two stations. A total of Forty two (42) species of benthic macro-invertebrates were recorded of which three (3) major phyla (*Arthropoda, Annelida and Mollusca)* were identified namely, the most abundant species of *Thiara tuberculata and Chaoborus* 5.61%, *Lamellidens corricaunus* 5.26%, Chaoborus sp. 5.19%, Lymnea auricularia 4.59%, Lymnaea acuminate 4.39%, Lamillidens Consobrinus 4.19%, Chaoborus sp. 4.63%, Tubifex albicola 4.09% and *Chironomus sp.*3.42% respectively. The high values of BOD and Total Hardness and the abundance of (*Arthropoda, Annelida and Mollusca)* a pollution-tolerant macro-invertebrate indicate that the river is likely under pollution stress.

Keywords: Physico-chemical parameters, Macro-invertebrates, Pollution, Kunda River.

1. INTRODUCTION

Benthic macro-invertebrates fauna are those organisms that live on or inside the deposit at the bottom of a water body (Idowu and Ugwumba, 2005). Water quality are those physical, chemical and biological factors that influence species composition, diversity, stability, production and physiological conditions of indigenous populations of a water body (Boyd, 1982). Studies on water quality management using macro-invertebrates in evaluating the impacts of specific pollutants in aquatic environments have been reported (Ogbeibu, 2001; Hart and Zabbey, 2005; Arimoro and Ikomi, 2007; George et al., 2009; Esenowo and Ugwumba, 2010).

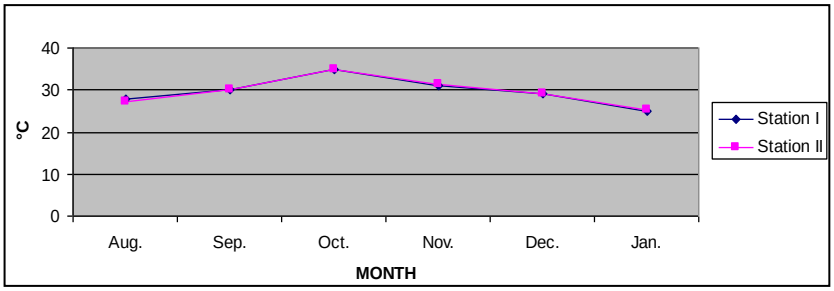

Figure 1

Line diagram showing Monthly Fluctuation of Temperature of Kunda River (August 2010 to January 2011)

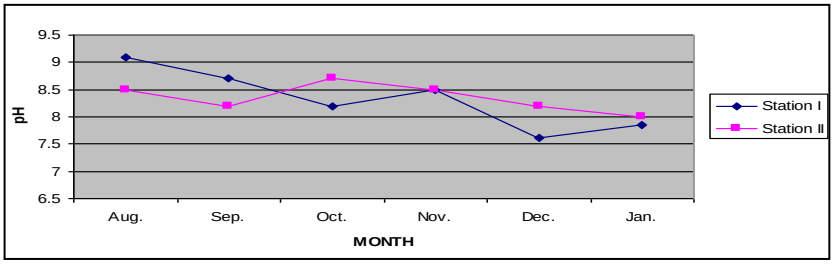

Figure 2

Line diagram showing Monthly Fluctuation of pH of Kunda River (August 2010 to January 2011)

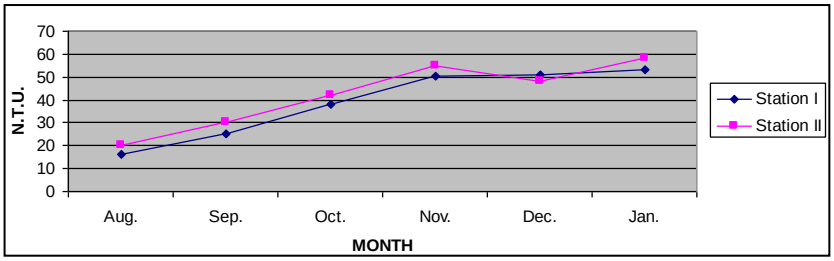

Figure 3

Line diagram showing Monthly Fluctuation of Transparency of Kunda River (August 2010 to January 2011)

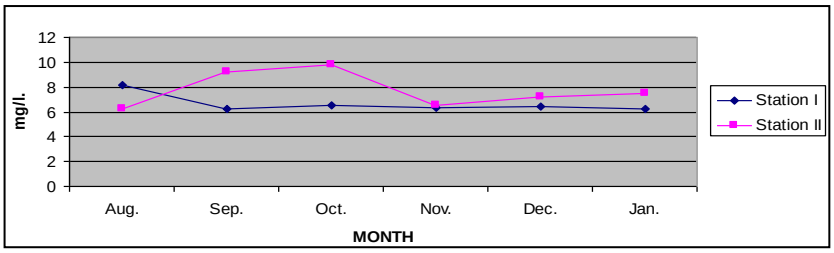

Figure 4

Line diagram showing Monthly Fluctuation of Dissolved oxygen of Kunda River (August 2010 to January 2011)

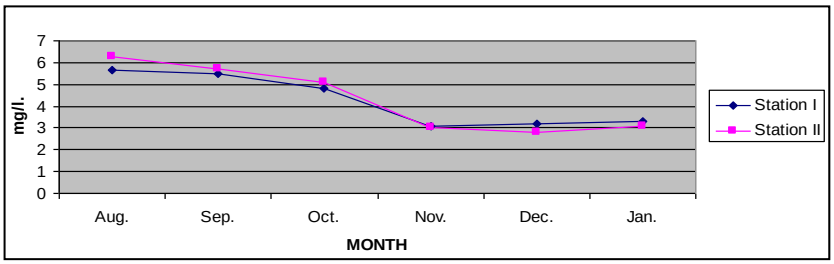

Figure 5

Line diagram showing Monthly Fluctuation of Biochemical Oxygen Demand of Kunda River (August 2010 to January 2011)

Benthic Macro-invertebrates have also been identified and the highest species number was recorded near tributaries due to the availability of food while the lowest are in the impacted areas where there are pollution discharges and gravel excavation (Beqiraj et al., 2006). According to Danes and Hynes (1980), occurrence and distribution of macro-invertebrate are governed mostly by the physical and chemical quality of water and immediate substrate of occupation. Temperature, dissolved oxygen, pH and nutrients have considerable effects on the life of aquatic organisms. Macro-invertebrates play an important role in aquatic community which includes mineralization, mixing of sediments and flux of oxygen into sediment, cycling of organic matter and also in assessing the quality of inland water (George et al., 2009). The distribution of macro-invertebrates fauna is determined by a number of factors such as the physical nature of the substratum, depth, and nutritive content, degree of stability and oxygen content of the water body. Macro-invertebrate organisms are threatened by changes in their habitat which are associated with pollution, erosion and siltation (Lydeard et al., 2004). The use of macro-invertebrate diversity for bio-assessment provides a simpler approach and this is due to the fact that they can be sampled quantitatively as well as the known relative sensitivity or tolerance of some of them to contamination (Adakole and Annune, 2003). Species vary in their degree of tolerance with the result that under polluted conditions, a reduction in species diversity is the most obvious effect (Rosenberg and Resh, 1993; Edokpayi et. al., 2000; Emere, 2000; Olomukoro and Egborge, 2003).

Khargone District climate is changed thus water of Kunda River is absorbed and water pollution amount is increased day by day. All of them use Kunda river water for their water requirements and either directly or indirectly all their effluents reach Kunda river causing severe pollution, affecting agriculture and Effluent from waste dumps are discharged to receiving water bodies causing severe environmental damage. The aims and objectives of this research is to assess the water quality of river Kunda using Physico-chemical Parameters and biodiversity of aquatic Benthic Macro-invertebrates.

2. MATERIALS AND METHOD

2.1. Study Area

River Kunda at Khargone district lies between longitude 75°36'4"E and latitude 21°49'16" N. It's originated from Amba forest and Sirvel village. River Kunda has a length of approximately 169Kms. and its catchment area of 3825sq.km. Its river situated in the west directions of M.P. and its flows from South to North through four block of Khargone district Bhagwanpura, Goganwa, Khargone, and Kasrawad. The river is a dump site for domestic wastes and raw sewage due to high population and rapid urbanization. Two sampling stations were selected in the river.

2.2. Dejla-Devada Dam

Dejla-Devada Dam is situated on Kunda River. It is 5km. away from Bhagwanpura Tehsil in Khargone district of western Madhya Pradesh. Its total length is 6010m. And Its 357.20m. High from the deepest foundation level. Its Irrigation area is about 8000 hectare. Its water holding area is 335.40 sq. km. and its complete storage capacity is 56.35million cubic meter, its total dam surface 383.20m. And its maximum dam surface 38920m. Its latitude $21^0$36'45'' (DMS) N & longitude $75^0$37'30'' (DMS) E.

2.3. Confluence with Undri River

Undri River is a tributary river of Kunda river. This place is situated 12km away From the Dejla-Devada dam. At this village Undri river confluence in Kunda River this village is called Bagdhari. At this place Garhi-Galtar project has made, which provided Irrigation facility to near about 1157 km. hectare Land. Its latitude $20^0$41'30'' (DMS) N & longitude $75^0$52'15'' (DMS) E.

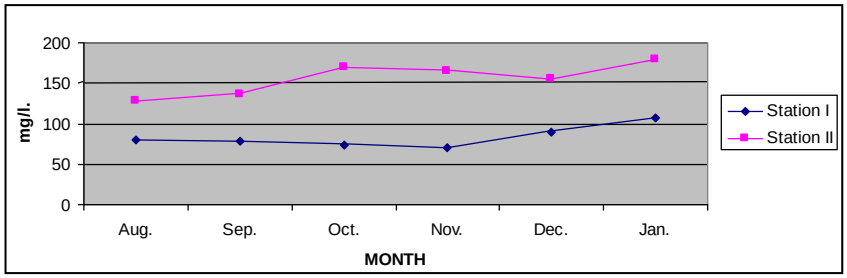

Figure 6

Line diagram showing Monthly Fluctuation of Total Hardness of Kunda River (August 2010 to January 2011)

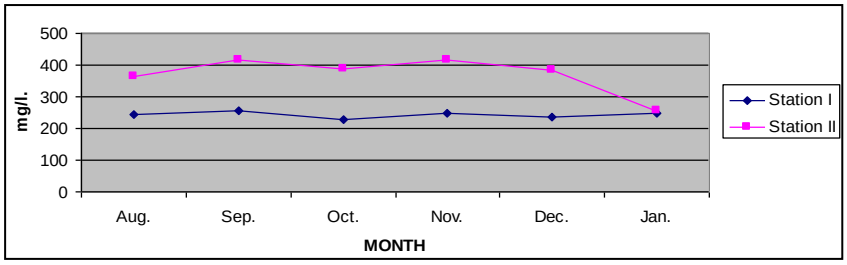

Figure 7

Line diagram showing Monthly Fluctuation of Alkalinity of Kunda River (August 2010 to January 2011)

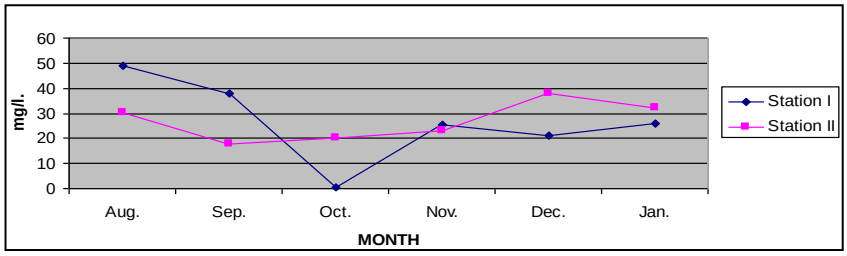

Figure 8

Line diagram showing Monthly Fluctuation of Chloride of Kunda River (August 2010 to January 2011)

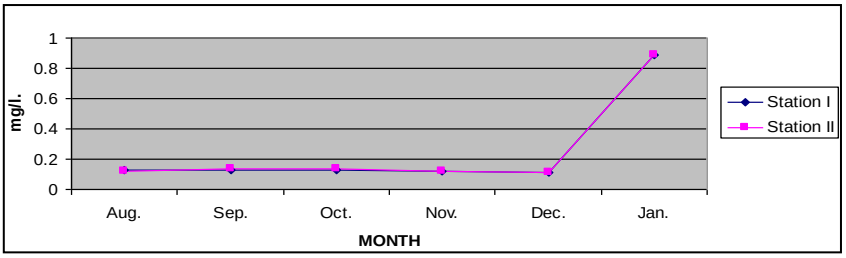

Figure 9

Line diagram showing Monthly Fluctuation of Nitrate of Kunda River (August 2010 to January 2011)

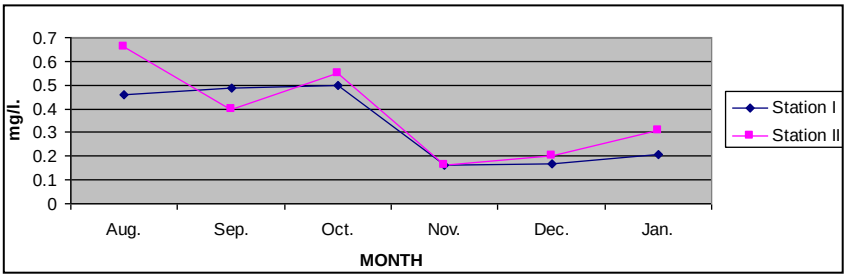

Figure 10

Line diagram showing Monthly Fluctuation of Phosphate of Kunda River (August 2010 to January 2011)

2.4. Determination of Physicochemical Parameters

The water samples were collected from the two selected sampling stations viz., Dejla-Devada Dam = S I, Confluence with Undri river = S II, in the Kunda River for the period of Six month from August 2010 to January 2011. In the analysis of the physico- chemical properties of water, standard method prescribed in limnological literature were used. Temperature, pH, Transparency, Dissolved Oxygen were determined at the site while Biochemical oxygen demand, Total Hardness, Alkanity, Chloride, Nitrate, Phosphate were determined in the laboratory. The Physico- Chemical parameters were determined by standard methods of APHA (2002), Welch (1998), Golterman (1991). All the chemicals used were of AR grade.

2.5. Benthic Macroinvertebrate

Macroinvertebrates samples were collected using a Van-veen grab of 0.6m2 surface area from each sampling station. Each sediment sample was diluted with water and sieved with mesh sizes 0.5mm (Holme and Mclntyre, 1984; George *et al.*, 2009). The residuals retained on the screens of the sieves were washed into a shallow white tray with water for sorting. The sorted macro-invertebrates organisms were preserved in 4% formalin in small glass jars. The individual organisms were identified macroscopically using the guides of Macan (1959), Pennak (1978), Edmunds (1978) and WHO (1978) and the number were counted.

3. RESULTS AND DISCUSSION

3.1. Physico-chemical Analysis

The result of the physico-chemical parameters of the two sampling station analyzed is presented in Table 1 and 2 and Monthly Fluctuation of physicochemical parameters is presented in Figure 1-10.

3.2. Temperature

Temperature is one of the most important parameters that influence almost all the physical, chemical and biological properties of water and thus the water chemistry. In the present study temperature varied from 25°C –35°C. The minimum temperature was recorded in the month of January at S I and maximum was recorded in the month of October at S I and S II. The mean value of the temperature recorded was 29.66°C. In the present study water temperature was recorded between 25°C –35°C (Fig.1). Sharma et al., (2001), Yogesh et al., (2001) also reported the same type of fluctuation in various freshwater bodies.

3.3. pH

pH–Potential of hydrogen, is the measure of the concentration of hydrogen ions. It provides the measure of the acidity or alkalinity of a solution. In the present study the observed pH values ranging from 7.61 and 9.3 show that the present water samples are slightly alkaline (Fig.2). The mean pH value of the water was found to be 8.34. These values are within maximum permissible limited prescribed by WHO (1993). Our results tally with the findings of Sharma et al., (2004).

3.4. Transparency

Transparency is a characteristic of water that varies with the combined effect of colour and turbidity. It measures the depth to which light penetrates in the water body. In the present study the value of transparency varied from 16(NTU) – 58 (NTU) the mean value of the Transparency recorded was 40.59 (NTU). The highest Transparency unit was 58 (NTU) obtained and the lowest was 16 (NTU). (Fig.3), Jain and Sharma (2000) also reported lowest transparency in rainy season and maximum in winter.

3.5. Dissolved Oxygen (DO)

Dissolved oxygen in natural and waste water depends on the physical, chemical and biological activities in the water body. Dissolved Oxygen (DO) content, plays a vital role in supporting aquatic life and is susceptible to slight environment changes. DO an important limnological parameter indicating level of water quality and organic pollution in the water body (Wetzel and Likens, 2006). In present study concentration of DO in Kunda river water samples varied from 6.2 mg/l to 9.8 mg/l with minimum in the month of August at S II and maximum in the month of October at S II (Fig.4). The mean value of the Dissolved Oxygen (DO) recorded was 6.86mg/l. The seasonal variation of DO in water depends upon the temperature of the water body which influences the oxygen solubility in water.

3.6. Biochemical oxygen demand

The biochemical oxygen demand, abbreviated as BOD, is a test for measuring the amount of biodegradable organic material present in a sample of water. In present study the BOD was ranged between 2.8 mg/l to 6.3 mg/l with minimum at S II in the month of December and maximum at S II in the month of August (Fig.5). The mean value of the Biological Oxygen Demand (BOD) 4.29mg/l similar observations were confirmed by many other workers such as Pathak and Mudgal (2005), Khanna (2003). The high level of BOD might have been attributed to the discharge of pollutants into the river through washing, sewage contamination, industrial affluent and a like.

3.7. Total hardness

Total hardness is the parameter of water quality used to describe the effect of dissolved minerals (mostly Ca and Mg), determining suitability of water for domestic, industrial and drinking purposes The observation of total hardness reveals that the monthly variation in the water samples of Kunda river ranged between 71 mg/l to 180 mg/l with minimum at S I in the month of November and Maximum at S II in the month of January (Fig.6). The mean value of the Total Hardness recorded was 119.33mg/l. same results were also reported by Sharma et al., (2012).

3.8. Alkalinity

Alkalinity of water is a measure of weak acid present in it and of the cations balanced against them. The observation of alkalinity reveals that the monthly variation ranged from a minimum of 230 mg/l- 415mg/l. with minimum at S I in the month of October and maximum at S II in the month of September. (Fig.7) and the mean value of the Total Hardness recorded was 307.49mg/l. same results were also reported by Sharma et al., (2004).

3.9. Chloride

Chloride is one of the major inorganic anion in water and waste water. In present study the values of chloride varied between 0.3 mg/l to 38 mg/l with minimum in October at S I and Maximum in December at S II (Fig.8). The mean value of the Chloride recorded was 26.72mg/l. similar results have been observed by Ahmad (2004).

Table 1 [Station I] Physico-chemical parameters of river Kunda at Dejla-Devada dam for Six month (August 2010 to January 2011)

Month	Aug	Sep	Oct	Nov	Dec	Jan
Temperature(°C)	28	30	35	31	29	25
pH	9.1	8.7	8.2	8.5	7.61	7.84
Transparency (N.T.U.)	16	25	38	50.5	51.2	53
D.O. (Mg/l)	8.2	6.23	6.50	6.35	6.39	6.21
B.O.D. (Mg/l)	5.63	5.5	4.8	3.1	3.2	3.31
Total Hardness (Mg/l)	80	78	73	71	89	107
Alkalinity	245	255	230	250	235	250
Chloride (Mg/l)	49	38	0.3	25.4	21	26
Nitrate (Mg/l)	0.125	0.13	0.131	0.121	0.11	0.89
Phosphate (Mg/l)	0.46	0.49	0.5	0.16	0.17	0.21

Table 2 [Station II] Physico-chemical parameters of river Kunda at Confluence with Undri river for Six month (August 2010 to January 2011)

Month	Aug	Sep	Oct	Nov	Dec	Jan
Temperature(°C)	27.1	30.1	35	31.3	29.2	25.2
pH	8.5	8.2	8.7	8.5	8.2	8.0
Transparency (N.T.U.)	20	30	42	55	48	58
D.O. (Mg/l)	6.2	9.2	9.8	6.5	7.2	7.5
B.O.D. (Mg/l)	6.3	5.7	5.08	3.0	2.8	3.1
Total Hardness (Mg/l)	128	136	170	165	155	180
Alkalinity	365	415	390	415	385	255
Chloride (Mg/l)	30	18	20	23	38	32
Nitrate (Mg/l)	0.120	0.135	0.139	0.120	0.110	0.890
Phosphate (Mg/l)	0.66	0.40	0.55	0.16	0.20	0.31

Table 3 (Station- I) (DEJLA-DEVADA DAM): Results of Benthic Macro-invertebrates identified from Kunda River shows the number species and percentage of occurrence of aquatic benthic macro-invertebrates recorded during the study period

Name of group and Species	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Total No	Relative Abundance (%Number)
Oligocheates								
Tubifex tubifex	Nil	10	12	08	12	03	45	2.00
Limmodrilus hoffmeisteri	Nil	04	09	05	03	02	23	1.02
Telmatodrilusmultispinosus	Nil	04	10	05	12	08	39	1.74

Table 3 (Station- I) (DEJLA-DEVADA DAM): Results of Benthic Macro-invertebrates identified from Kunda River shows the number species and percentage of occurrence of aquatic benthic macro-invertebrates recorded during the study period

Name of group and Species	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Total No	Relative Abundance (%Number)
Dero dorsalis	Nil	05	07	10	15	06	43	1.92
Stylaria fossularis	Nil	-	03	02	-	04	09	0.40
Branchiodrillus hortensis	Nil	09	10	07	05	08	39	1.74
Tubifex albicola	Nil	15	20	25	22	10	92	4.09
Dero digitata	Nil	09	10	15	14	08	56	2.49
Dero cooperi	Nil	05	03	07	05	12	32	1.43
Crustacians (1)								
Daphnia cercinata	Nil	06	02	04	08	03	23	1.02
Pina dubia	Nil	06	08	11	14	12	51	2.27
Cypris	Nil	06	08	10	15	12	51	2.27
Cyclopes	Nil	05	07	12	10	08	42	1.87
Neso cyclopes	Nil	07	07	09	12	11	46	2.05
Nauplius	Nil	02	07	14	17	12	52	2.32
Prawn	Nil	03	04	05	06	03	21	0.94
Gastropoda(/M²)								
Pila globosa	-	12	14	18	20	23	87	3.88
Thiara scabra	-	12	15	14	20	25	86	3.83
Bellamya bengalensis	-	05	10	15	12	20	62	2.76
Thiara lineata	-	10	12	12	15	24	73	3.25
Thiara tuberculata	-	13	22	29	32	30	126	5.61
Vivipara bengalensis	-	10	12	12	16	12	62	2.76
Digiostana pulchella	-	08	12	15	18	20	73	3.25
Pelecypoda (/M²)								
Lymnaea acuminate	-	10	11	13	12	14	60	2.67
Lymnea auricularia	-	08	10	12	11	13	44	1.96
Lamellidens corricaunus	-	08	12	10	13	15	58	2.58
Lamellidens consobrinus	-	04	05	10	12	18	49	2.18
Lamellidens lamellatus		08	11	12	15	15	61	2.72
Pisidium clarkeanum	-	05	08	11	15	14	53	2.36
Corbicula striatella	-	10	12	15	14	20	71	3.16
Melanoides tuberculates	-	05	09	12	17	20	63	2.81
Baetidac -								
Baetiella sp.	-	05	02	04	06	03	20	0.89
Baetis sp.	-	02	08	05	04	08	27	1.20
Baetis simplex	-	01	05	08	02	07	23	1.02
Baetis festivus	--	05	07	09	10	14	45	2.00
Caenoidac -								
Caehis sp.	NIL	05	12	14	15	11	57	2.54
Ephemeridac -								
Ephemera Nadinac	NIL	06	10	17	10	12	55	2.45
Heptageniidac -								
Epeorus sp.	-	05	06	08	09	07	35	1.56
Epeorus sp.	-	01	05	07	09	10	32	1.43
Heptagenia nubile	-	05	07	10	12	15	49	2.18
Chironomidae-*chironomus sp.*	10	11	17	18	13	15	84	3.74
Chaoborus sp.	12	12	20	27	25	30	126	5.61

Table 4 (Station-II) (CONFLUENCE WITH UNDRI RIVER): Results of Benthic Macro-invertebrates identified from Kunda River shows the number species and percentage of occurrence of aquatic benthic macro-invertebrates recorded during the study period

Name of group and Species	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Total No	Relative Abundance (%Number)
Oligocheates								
Tubifex tubifex	Nil	15	20	25	22	10	92	3.12
Limmodrilus hoffmeisteri	Nil	09	10	15	14	08	56	1.89
Telmatodrilusmultispinosus	Nil	10	12	10	14	18	64	2.16
Dero dorsalis	Nil	06	15	20	25	30	96	3.24
Stylaria fossularis	Nil	10	13	12	18	14	67	2.26
Branchiodrillus hortensis	Nil	05	03	07	05	12	32	1.08
Tubifex albicola	Nil	07	03	05	12	18	45	1.52
Dero digitata	Nil	06	08	06	20	19	59	1.99
Dero cooperi	Nil	03	08	12	13	15	51	1.72
Crustacians (1)								
Daphnia cercinata	02	10	15	20	10	15	72	2.43
Pina dubia	-	3	7	18	3	7	38	1.28
Cypris	05	8	14	22	8	14	66	2.23
Cyclopes	01	7	9	10	7	9	42	1.42
Neso cyclopes	03	3	5	7	3	5	23	0.78
Nauplius	01	8	6	9	8	6	37	1.25
Prawn	02	10	15	20	10	15	70	2.36
Gastropoda(/M²)								
Pila globosa	02	12	15	18	19	20	86	2.90
Thiara scabra	01	08	10	12	18	15	63	2.13
Bellamya bengalensis	02	10	12	18	13	20	73	2.46
Thiara lineata	-	08	12	17	19	22	78	2.63

Table 4 (Station-II) (CONFLUENCE WITH UNDRI RIVER): Results of Benthic Macro-invertebrates identified from Kunda River shows the number species and percentage of occurrence of aquatic benthic macro-invertebrates recorded during the study period

Name of group and Species	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Total No	Relative Abundance (%Number)
Thiara tuberculata	-	05	17	13	15	25	75	2.53
Vivipara bengalensis	01	06	09	10	15	20	61	2.06
Digiostana pulchella	-	10	12	15	12	15	64	2.16
Pelecypoda ($/M^2$)								
Lymnaea acuminate	-	20	30	35	25	20	130	4.39
Lymnea auricularia	02	15	20	24	35	40	136	4.59
Lamellidens corricaunus	05	19	27	30	35	40	156	5.27
Lamellidens consobrinus	02	10	20	20	30	42	124	4.19
Lamellidens lamellatus	02	10	12	15	20	35	94	3.17
Pisidium clarkeanum	02	10	14	17	29	35	107	3.61
Corbicula striatella	08	12	18	20	25	30	113	3.81
Melanoides tuberculates	02	12	18	20	25	30	107	3.61
Baetidac -								
Baetiella sp.	NIL	04	07	08	10	12	41	1.38
Baetis sp.	-	02	04	07	09	10	32	1.08
Baetis simplex	-	02	06	08	10	09	35	1.18
Baetis festivus	02	08	09	07	10	12	48	1.62
Caenoidac -								
Caehis sp.	-	02	05	08	10	07	32	1.08
Ephemeridac -								
Ephemera Nadinac	NIL	02	03	05	07	05	22	0.74
Heptageniidac -								
Epeorus sp.	02	03	05	09	10	12	41	1.38
Epeorus sp.	-	05	10	10	12	15	52	1.75
Heptagenia nubile	01	03	07	11	14	17	53	1.78
Chironomidae-*chironomus sp.*	14	15	17	18	13	15	92	3.11
Chaoborus sp.	20	15	20	27	25	30	137	4.63

3.10. Nitrate

Nitrates are the most oxidised forms of nitrogen and the end product of the aerobic decomposition of organic nitrogenous matter. Nitrogen is an essential building block in the synthesis of protein. The evaluation of nitrogen is therefore an important parameter in understanding the nutritional status of water bodies. The concentration of nitrate in Kunda river water was found to be in the range of 0.110 mg/l to 0.890 mg/l. Minimum nitrate concentration was recorded at S I in the month of December and maximum was also recorded at S I in the month of January (Fig.9) and the mean value of the Nitrate recorded was 0.251mg/l. Nitrate is attributed mainly due to anthropogenic activities such of run of water from agricultural lands, industrial wastes, discharge of house hold and municipal sewage from the market place and other effluents containing nitrogen. Such observations were also reported by Royer et al., (2004).

3.11. Phosphate

Phosphorous is one of the most important nutrients limiting the growth of autotrophs and biological productivity of the system. High phosphorus content causes increased algal growth, often as blooms, till nitrogen becomes limiting. During the present study the values of phosphate fluctuated between 0.5 mg/l to 0.66 mg/l. the maximum phosphate was recorded at S II in the month of august and minimum was also recorded at S I in the month of October (Fig.10). Similar values were also observed by Jain (2000). The increased use of fertilizers, use of detergents and domestic sewage greatly contribute to the heavy loading of phosphorus in the water.

3.12. Benthic Macro-invertebrates Composition and Abundance

The benthic macro-invertebrates encountered in the river during the study period is shown in Table 3 and 4. Four class and Five families of benthic macro-invertebrate organisms represented by forty two species were recorded. The mollusc Thiara tuberculata and Arthropods Chaoborus species was the most abundant accounting for about 5.61%, *Lamellidens corricaunus* 5.26%, Chaoborus sp. 5.19%,

Lymnea auricularia 4.59%, Lymnaea acuminate 4.39%, Lamillidens Consobrinus 4.19%, Tubifex albicola 4.09% and *Chironomus sp.*3.42% respectively. The least abundant was Stylaria fossularis sp. This accounted for 0.40% (Table 3, 4). The result further revealed that of the 3 phyla identified, Arthropods were dominant. This conforms to the research findings of Mellanby (1997) that arthropods are adapted to life diverse habitats due to their mode of feeding, behavior, physiology and physicochemical parameters. The monthly variation in the density of macro-invertebrates as observed from the study could be to the variation in the physic-chemical factors which also indicates the presence of dissolved organic matter at Kunda River. The population density of living organisms in aquatic environment usually various with the variation of environmental parameters.

The presence of pollution-tolerant macroinertebrate such as Chironomus sp., Lymnaea truncatula and Lymnaea glabra could be attributed to the effect of domestic and industrial wastes in the river. The low DO and high BOD values recorded in the present study may have favour the presence of these pollution indicator species. The adaptations of Chironomus sp. include possession of pigment hemoglobin which gives it a high affinity for oxygen (Mason, 1991), hence their tolerance of low DO. These are characteristic species in water showing some degree of change due to anthropogenic activities in the river. Their high presence is a common feature of organically polluted water bodies (Chindah et al., 1999; Miserendino and Pizzolon 2000; Ogbogu and Olajide 2002; Tyokumbur et al., 2002; Negishi and Richardson 2003; Atobatele et al., 2005; Arimoro and Osakwe 2006). Studies on Ogunpa River were on physico-chemical parameters and macro-invertebrates fauna (Atobatele *et al.,* 2005; Adeyemo *et al.,* 2008 and Ogidiaka Efe 2012). Same results were also reported by (George et al., 2009; Indabawa 2010 and Tampus et al., 2012).

4. CONCLUSION

The study revealed that Kunda River at Khargone district Madhya Pradesh, India is polluted as indicated by low DO, high BOD and Total Hardness values and abundance of pollution tolerant benthic macro-invertebrate hence proper management of the river.

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